DOES HARVESTING HEDGES FOR WOODFUEL CONFLICT WITH THEIR DELIVERY OF OTHER ECOSYSTEM SERVICES?

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Introduction

Hedges are the traditional boundary feature across much of lowland Northern Europe. The abundance of hedgerows in landscapes otherwise dominated by agriculture makes them a vital resource for biodiversity (Baudry *et al*., 2000), as well as providing a range of other ecosystem services including the including regulation of water quality and quantity, buffering natural habitats from agricultural inputs (Baudry *et al*., 2000), crop pest control (Ricci *et al*., 2009), carbon sequestration (Falloon *et al*., 2004) and provisioning of food, fuel and fibre. The main threat to hedges and the services that they provide are changes in management practices related to agricultural intensification and a reduction in the perceived value of hedges to farmers (Oreszczyn and Lane, 1999). Management for woodfuel provides a mechanism by which to encourage the reintroduction of active management into farm hedgerows. However there are concerns that provision of woodfuel may conflict with other ecosystem services that the hedgerow network supports. Potential impacts include an alteration of the hedge microclimate, changes in hedge structure, plant species composition and landscape connectivity. It is expected that the introduction of coppice management cycles will tend to make hedgerow systems more dynamic increasing the habitat heterogeneity within a landscape, with different species and communities associated with different ages of re-growth and this may lead to an increase in overall biodiversity. However there are likely to be some trade-offs, for example, reduced connectivity between patches of semi-natural habitats for species that use the hedgerows as corridors, such as dormice (*Muscardinus avellanarius)* have been found to be gap adverse (Bright, 1998) and may be adversely affected by coppicing.

Aiming to address these concerns, the Organic Research Centre (ORC) has carried out trials at two sites in southern England during winter 2014/15 (Chambers *et al*., 2015). The trials examined the potential productivity of traditional boundary hedges in terms of woodfuel as well as looking into the economics of different management strategies (**Figure 1**). Alongside these trials an assessment of the impacts of hedge management for woodfuel on ecosystem services was carried out, with a particular focus on biodiversity and carbon sequestration. A protocol to measure the biodiversity impacts was developed (Crossland *et al*., 2015) and soil carbon stocks were measured in paired coppiced and un-coppiced hedge plots (Crossland, 2015).

Figure 1: Hedgerow harvesting trials using tree shears on a hazel hedgerow, UK

Provision of fuel

The hedge trials focussed on coppicing and chipping as the management methods best suited to woodfuel production (Wolton, 2012). A key knowledge gap when considering hedge management for woodfuel is a lack of information on the potential productivity of a hedge over a coppice cycle of 10 - 20 years. To address this prior to coppicing each hedge section, the biomass was estimated and then after cutting the actual biomass was measured. This data was used to calibrate and improve an existing tool to estimate the biomass available in hedgerows (Wolton, 2014). Depending on hedge species, age and management history of the hedge biomass production ranged from 40 kg to 120 kg per metre of hedge with taller, more mature, hedges composed of lines of small trees giving the highest biomass per metre (Chambers *et al*., 2015). The unit energy cost of hedgerow woodchip produced ranged from 1.4 to 3.9 pence per kilowatt hour (p/kWh) depending on machine options and hedge type, and would seem relatively favourable when compared to the cost of other woodfuels (3.43-5.21p/kWh), fossil fuels (3.5-8.33p/kWh) and electricity (12p/kWh) (Forest Fuels, 2015). The trials were also successful in proving that woodchip that meets industry standards (P16B and G30 grades under BS EN and ÖNORM woodfuel standards respectively) can be produced from traditional boundary hedgerows, which had been a concern of industry stakeholders. These trials highlighted the fact that due to the limited volumes that can be sustainably harvested and the bulky nature of hedge biomass, management of hedges for woodfuel is more suited to smaller decentralised short chain energy production systems, ideally on-farm or for small district heating schemes.

Carbon sequestration

The study of soil carbon stocks in paired coppiced and un-coppiced hedge plots revealed that while un-coppiced hedges sequester larger quantities of carbon, total carbon savings are higher when hedges are managed by coppicing (Crossland, 2015). This is mainly due to the substitution of fossil fuels via the production of woodfuel. Although the results presented from this small-scale, short-term study should be viewed as provisional, they present a useful starting point for future enquiry, identifying the need for long-term chronological studies and data collection on carbon sequestration processes specific to hedges. Collection of further empirical data on the carbon sequestration potential of hedgerows will be needed to validate existing estimates and models and to inform decisions not only at a farm management level but also for wider policy.

Biodiversity

Management for woodfuel is likely to have both positive and negative impacts on the wildlife of individual hedges and on biodiversity at a landscape scale. Biodiversity in British hedgerows has been well studied and hedgerows have been found to offer multiple micro-habitats, food sources, and ecological corridors for a diverse range of flora and fauna (Baudry *et al*., 2000; Vickery *et al*., 2009). Given their significance in supporting biodiversity and ecosystem services, if hedgerows are to be promoted as a source of woodfuel, any potential biodiversity impacts need to be assessed. Alongside the practical trials a biodiversity protocol has been developed by the Organic Research Centre (Crossland *et al*., 2015). This protocol provides a simple methodology to assess the biodiversity status of a hedge network prior to changes in management giving a baseline for comparison whilst also identifying hedges that are home to key species with specific management requirements. The protocol is largely based on a set of indicators selected to provide quantitative links between, for example, habitat quality or structural diversity and biodiversity (Dauber *et al*., 2003). In order to make the results widely relevant, the methodologies developed to measure each indicator were based on existing surveys, for example, the DEFRA hedge survey (DEFRA, 2007) and the British Trust for Ornithology's breeding bird survey. The main indicators included in the protocol are; hedge connectivity, hedge network density, the density of hedgerow trees, hedge structural diversity, the percentage of hedges in favourable condition, and the percentage of hedges providing a good food resource. After carrying out the survey these indicators are scored and the results represented visually using a radar diagram (**Figure 2**). This gives an overall picture of the biodiversity value of a hedge network and the relative value of individual hedges within the network. Using data collected in the survey the protocol also identifies hedges suitable for harvesting woodfuel as well as those in need of improvement and offers general management recommendations based on different indicators. The protocol has however had relatively little testing to date and represents just one approach to quantifying hedgerow biodiversity. There are many other assessment methods and potential indicators which have not been included.

Through future use, the protocol can be further developed and improvements made to the indicators and how they are calculated and scored.

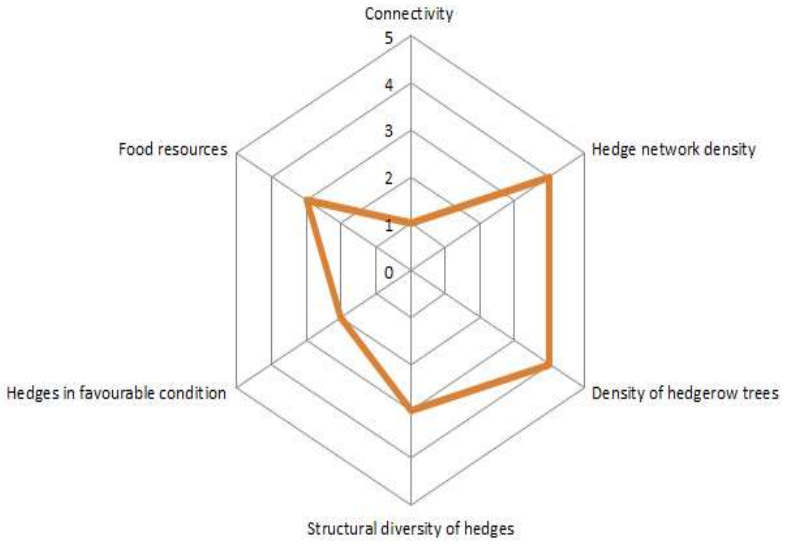

Figure 2: An example radar diagram of the hedge survey indicator results.

Conclusions

A key conclusion from the ORC trials is that every hedge is different, and every hedge has to be assessed and managed on its own merits. The biodiversity protocol provides a mechanism with which to assess a hedge network prior to management in order to identify hedges suitable for harvesting woodfuel, those with high biodiversity value, as well as those in need of improvement. These trials demonstrate that managed correctly the use of traditional farm boundary hedges for woodfuel can be both economically viable and beneficial not only in terms of energy production, but also make sense environmentally, for example, in terms of improving the long-term viability of hedges, connectivity in the landscape and carbon sequestration. The next step is to investigate how to increase the quality of the woodchip from hedgerows and the potential for other new products from the woodchip such as landscaping mulch; compost; or livestock bedding. Starting in March 2016, 'SustainFARM' is a new EU funded project which will look further into these other provisioning services as well as model the agronomic, environmental and economic performance of these and other integrated food and non-food production systems.

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